ENDELOCRINUS KIERI, A NEW CRINOID FROM THE AMES LIMESTONE[1]

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ABSTRACT

A new species of cladoid inadunate crinoid, *Endelocrinus kieri* sp. n. from the Ames Limestone, Conemaugh Group, Pennsylvanian, is described. The Conemaugh form is closely related to *Endelocrinus rectus* Moore and Plummer from the Strawn Group of Texas, although more specialized than the Texas species. The retention of ornamented species in *Endelocrinus* is advocated. The validity of the Strimple genera *Tholiacrinus* and *Graffhamicrinus*, which are based on surface ornamentation, is questioned.

The new species of *Endelocrinus* described in the following pages is based on specimens collected from the Ames Limestone, Conemaugh Group, Pennsylvanian, in Guernsey County, Ohio, and in Brooke County, West Virginia. The type material shows growth stages and variations that are pertinent to an understanding of *Endelocrinus* in general, and because the species is more specialized than the related *Endelocrinus rectus* Moore and Plummer of Desmoinesian age, it may prove of value in stratigraphic correlation.

I am indebted to Dr. E. R. Eller of the Carnegie Museum and Mr. Thomas J. M. Schopf of the Orton Museum of the Ohio State University for the loan of crinoid material to supplement this study. Dr. Porter M. Kier of the United States National Museum, for whom this new species is named, has been especially kind in permitting me to have access to the crinoid collections of that institution during my visits to Washington. I also wish to thank Mr. Calvin Colson of Ohio University, for making the photographs from which the illustrations were prepared.

The type specimens are from my private collection and have been presented to the United States National Museum.

SYSTEMATIC PALEONTOLOGY

Family Erisocrinidae Miller, 1889

Genus *Endelocrinus* Moore and Plummer, 1940

Endelocrinus kieri sp. n.

Fig. 1–12

Delocrinus allegheniensis Burke, 1932, [part], Ann. Carnegie Mus. vol. 22, p. 89–91, pl. 3, fig. 5, 5a, 5b [*not* figs. 1–4b].

Diagnosis: Related to *Endelocrinus rectus* Moore and Plummer, but a larger species (width range of dorsal cups 8 to 15.2 mm) and cup plates more globose, with strongly outjutting radials; basal concavity shallower, with basals, rather than infrabasals composing most of the wall of the cavity.

Types: Four dorsal cups. Holotype, U.S.N.M. No. 145620; paratypes U.S.N.M. Nos. 145583, 145584, and 145585.

Occurrence: Ames Limestone, Conemaugh Group, Upper Pennsylvanian, Ohio and West Virginia.

Localities: The holotype, U.S.N.M. No. 145620, from a roadside exposure on the north side of Ohio Route 265 in SE¼ SE¼ Sec. 26 (lat. 39° 58′ 17″ N., long. 81° 18′ 42″ W.) Millwood Twp. near Quaker City, Guernsey County, Ohio. Paratypes U.S.N.M. Nos. 145583, 145584, 145585 from an excavation (Tunnel Road Cut) for West Virginia Route 67 (lat. 40° 14′ 24″ N., long. 80° 35′ 53″ W.) near McKinleyville, Brooke County, West Virginia.

Repository: Smithsonian Institution, United States National Museum, Washington, D.C.

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Description and comparisons: For the most part the dorsal cup of this species resembles that of *Endelocrinus rectus* Moore and Plummer; both forms show the truncate bowl-shaped cup characteristic of most erisocrinids, but the basal and radial plates are quite globose.

In ventral or dorsal view, dorsal cups of young specimens of *Endelocrinus kieri* sp. n. are also, as are those of *Endelocrinus rectus*, subpentagonal, with the "angles" of the pentagon formed by the globose radials, but the radials tend to be nodose or unevenly truncate with increasing age, and the outline becomes less regular.

The dorsal cup is about three-fifths as wide as high. The basal concavity is not as high nor wide as that of *Endelocrinus rectus*, and the five infrabasals, which extend a little below the round stem impression, roof the concavity. In contrast with *Endelocrinus rectus*, in which species the infrabasals form most of the wall of the concavity, the basals constitute most of the wall in *Endelocrinus kieri*. Proximally the five basals slope steeply downward, but distally, especially in young individuals, they become quite globose, with strong curvature outward and to the sides, where they meet the radials, and even inward as they approach the tips.

The five radial plates are also quite globose, curving strongly to the sutures, and distinct hollows are present where the radials contact adjacent radials, basals, and anal X. One or two nodes or irregular rounded projections of the upper part of this globose area are found on the radials of older specimens. Distally an arcuate area, broadest at the midwidth of the plate, slopes inward to the articular facet. This is accompanied by a flattening of the outer surface, the plane of which approaches that of the articular facet. The flattening in this region is also characteristic of the radials of *Endelocrinus rectus*.

The outer ligament-pit furrow is short, slitlike, and its outer ridge sags downward. The ligament pit is small but distinct, and somewhat attenuated parallel to the furrow. The transverse ridge extends the full width of the radials and is denticulate. In the inner ligament area, the ligament fossae are fairly well defined and run parallel or subparallel to the transverse ridge. In general, the muscle areas slope outward, and the slope increases with age. The adsutural slopes are steep in mature individuals. The intermuscular notch is not prominent and varies from angular to rounded. The intermuscular furrow is narrow and short, and reaches to the apex of a triangular elevated area extending inward from the transverse ridge. There is a small pit on each side of the triangular area and indications of a central pit close to the inner side of the transverse ridge.

The anal X is small and hexagonal; about two-thirds of its height lies within the dorsal cup. It rests on the truncate distal extremity of the posterior basal and between the right and left posterior radials. Distally, the plate curves inward

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EXPLANATION OF FIGURES

All figures magnified ×2.

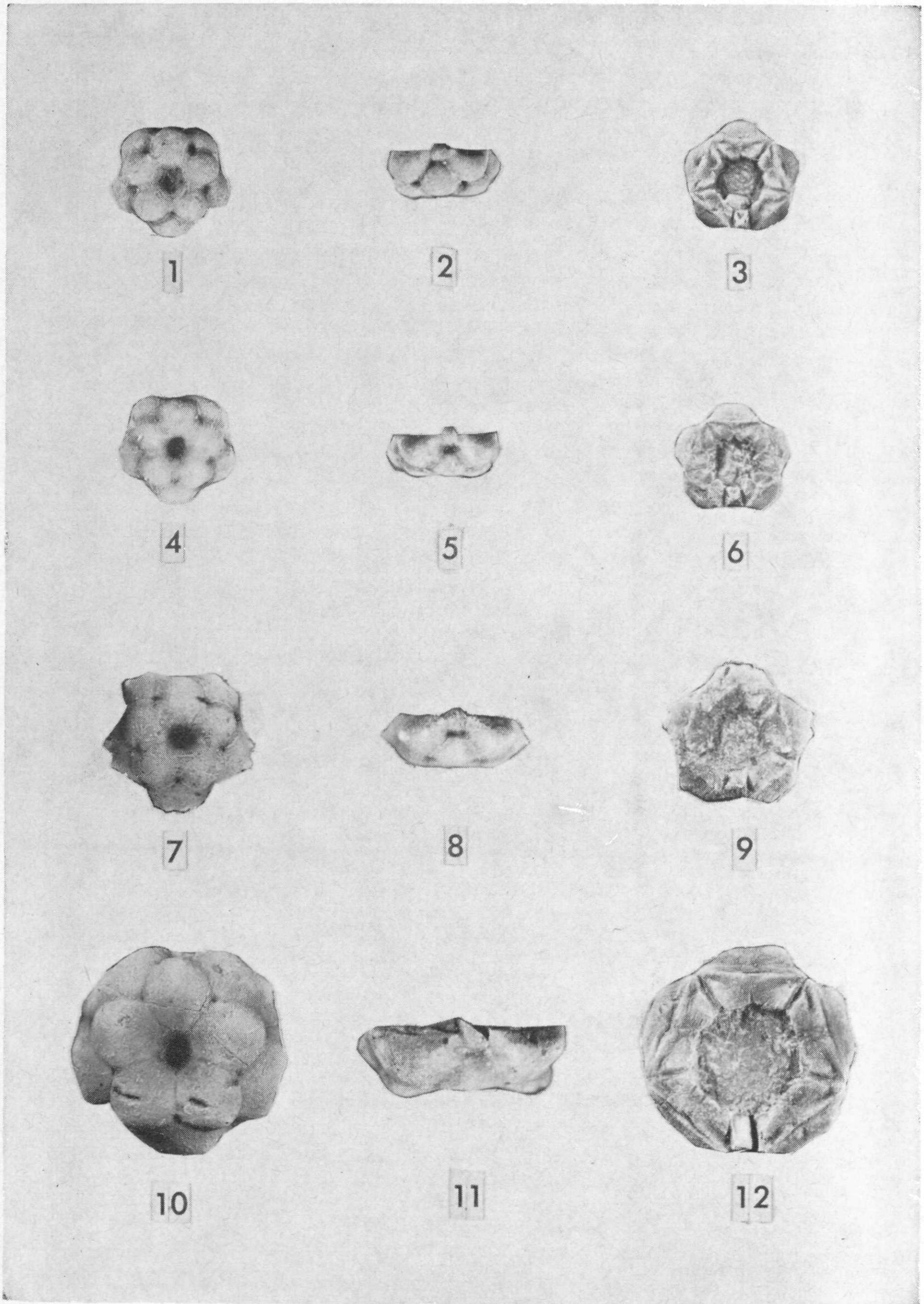
Endelocrinus kieri sp. n.

FIGURES 1–3. Holotype, U.S.N.M. No. 145620, from the Ames Limestone, Conemaugh Group, near Quaker City, Guernsey County, Ohio. Fig. 1, dorsal view; fig. 2, posterior view; fig. 3, ventral view.

FIGURES 4–6. Paratype, U.S.N.M. No. 145583, from the Ames Limestone, Conemaugh Group, near McKinleyville, Brooke County, West Virginia. Fig. 4, dorsal view; fig. 5, posterior view; fig. 6, ventral view.

FIGURES 7–9. Paratype, U.S.N.M. No. 145584, from the Ames Limestone, Conemaugh Group, near McKinleyville, Brooke County, West Virginia. Fig. 7, dorsal view; fig. 8, posterior view; fig. 9, ventral view.

FIGURES 10–12. Paratype U.S.N.M. No. 145585, from the Ames Limestone, Conemaugh Group, near McKinleyville, Brooke County, West Virginia. Fig. 10, dorsal view; fig. 11, posterior view; fig. 12, ventral view.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strongly, and terminates in an inward-sloping facet which made contact with another tube plate.

All of the dorsal cups referred to this species show pits characteristic of *Endelocrinus*, which are developed where the basals meet the apices of the radials and where the radials meet the apices of the basals. The contact of the posterior basal with anal X is marked by a transverse hollow, rather than a pit.

At a magnification of 40×, the plates of all these specimens show very fine granulose ornamentation.

Measurements of the type specimens have been taken as defined by Moore and Plummer (1940, p. 24–27) and are as follows:

	Holotype U.S.N.M. 145620	Paratype U.S.N.M. 145583	Paratype U.S.N.M. 145584	Paratype U.S.N.M. 145585
Height of dorsal cup	3.5	3.3	3.9	5.9
Width of dorsal cup	8.0	8.0	10.0	15.2
Ratio of height to width	.44	.41	.39	.39
Width of body cavity	3.2	3.5	4.7	7.5
Height of basal concavity	1.3	1.2	1.4	2.5
Width of basal concavity	3.3	3.4	4.3	8.7
Diameter of stem impression	0.9	0.8	1.2	1.5
Height of proximal margin of PB above basal plane	1.1	1.0	1.0	2.0
Height of distal margin of PB above basal plane	2.1	2.0	2.3	3.7
Ratio of height of proximal to distal margin of PB	.52	.50	.43	.54
Length of basal	4.3	4.0	5.0	8.3
Width of basal	3.5	3.2	3.7	5.5
Length of radial	4.0	4.0	4.4	6.1
Width of radial	5.5	5.5	6.3	10.0
Length of anal X	2.4	2.5	3.0	———
Width of anal X	1.4	1.3	1.5	1.9
Length of suture between the basals	1.7	2.0	2.3	3.5
Length of suture between the radials	1.4	1.6	1.7	2.6

Discussion: This crinoid bears close resemblance to *Endelocrinus rectus* Moore and Plummer, and may be a derivative of that species. The principal differences distinguishing *Endelocrinus kieri* from the Texas form appear to consist in (1) more globose plates of the dorsal cup, particularly the radials, which jut outward strongly at all stages of growth, (2) a shallower basal concavity, with the basals, rather than the infrabasals, constituting most of the wall of the concavity, and (3) greater size, for the largest specimen of *Endelocrinus rectus* figured by Moore and Plummer (1940, pl. 14, fig. 5) is only about two-thirds the size of my largest paratype, U.S.N.M. No. 145585.

Endelocrinus kieri also resembles *Endelocrinus allegheniensis* (Burke), with which it is associated in the Ames Limestone, in having globose radial and basal plates and in the extent to which the proximal portions of the basals participate in the basal concavity. However, the basals form more of the wall of the cavity in *Endelocrinus kieri*. The globosity of the basal and radial plates is also more pronounced in *Endelocrinus kieri* and their junctions are marked by strong hollows. The flattening of the distal outer surfaces of the radials, characteristic of *Endelocrinus kieri* and *Endelocrinus rectus*, is not shown in *Endelocrinus allegheniensis*. Furthermore, the latter species appears to have attained greater size than *Endelocrinus kieri;* the largest dorsal cup of *Endelocrinus allegheniensis* available for comparison is about 18 mm wide, as compared with a width of 15.2 mm for the largest paratype of *Endelocrinus kieri*, U.S.N.M. No. 145585.

However, in the course of this study I have had an opportunity to reexamine the type specimens of *Endelocrinus allegheniensis*, and I find that the smallest paratype, C.M. No. 4948, from the Ames Limestone in Schenley Park, Pittsburgh, Pa. differs in several respects from the other members of the suite. The basals of C.M. No. 4948 comprise more of the wall of the basal concavity than the basals of the other specimens, and the basals and radials are more globose, with strong hollows at their junctions. The low height of the cup is probably the result of wear. Although the distal outer surfaces of the radials are also worn, the right anterior radial may preserve some of the flattening characteristic of *Endelocrinus kieri*. Because of these features, I believe that C.M. No. 4948 is assignable to *Endelocrinus kieri*, rather than to *Endelocrinus allegheniensis*.

With increase in age of *Endelocrinus kieri*, there are some interesting modifications of the dorsal cup. The basal and radial plates become less globose, and the slopes between adjacent plates become gentler. The typical *Endelocrinus* pits persist, but those at the apices of the basals tend to be confluent with the interradial hollows. The proximal slopes of the basals lose some of their steepness, and the distal slopes of the radials become straighter and closer to the planes of the radial facets. As noted previously, in dorsal and ventral views, the outline becomes less regular because the radials develop irregular nodes or swellings. Finally, the radial facets show an appreciable strengthening of the articular surfaces; the muscle areas become elevated, facing outward more strongly, with steeper slopes, and the adsutural slopes steepen.

The radials of one of the paratypes, U.S.N.M. No. 145584, are nodose along the periphery. These nodes show considerable variation; they are paired on the left anterior radial, paired with incipient nodes flanking them on either side on the anterior radial, and paired on the right anterior radial, where one node is stronger than the other. There is a single node on one side of the left posterior radial, and a one-sided swelling of the right posterior radial. This one-sided swelling or asymmetrical bulging again characterizes the radials of my largest paratype, U.S.N.M. No. 145585. It is interesting to note that nodosity or asymmetrical bulging appears also to occur in the radials of mature specimens of *Endelocrinus rectus* (see Moore and Plummer, 1940, pl. 14, fig. 5).

The variations in size, shape, and placement of these nodes suggest that they represent regional accelerations in growth rate of the surfaces of these plates. Their presence as low rounded bulges in the largest paratype, U.S.N.M. No. 145585, would appear to indicate that they are being eliminated as the plates round out with continued growth. If the nodes are attributable to regional growth acceleration, it seems reasonable that there may have been individuals of the species in which the plates grew at a uniform rate, and these individuals might not have displayed nodose radials at any stage in their ontogeny.

Although I am inclined not to give much weight to nodosity as a specific character of this crinoid, nodosity and other forms of surface ornamentation appear to constitute fairly reliable means of distinguishing various other species of *Endelocrinus* and *Delocrinus*. However, attempts at generic distinction among erisocrinids based on surface ornamentation are open to serious question.

Strimple has apparently observed nodose ornamentation in *Endelocrinus rectus* and has included that form, together with several other ornamented species of *Endelocrinus*, in his proposed genus *Tholiacrinus* (Strimple, 1961, p. 128; 1962, p. 136). Surface ornamentation of various types is his only basis for separating these species from *Endelocrinus*. Strimple (1961, p. 123) has also proposed another genus, *Graffhamicrinus*, for ornamented species of *Delocrinus*.

Surface ornamentation in *Endelocrinus* and in *Delocrinus* is highly variable, apparently of diverse origin, and does not appear to represent any definite evolutionary trend or trends. This is true in other crinoid genera as well. In *Platycrinites* both smooth and ornamented species are represented and ornamentation appears to afford no basis for generic distinction (Wachsmuth and Springer, 1897, p. 651–652, et seq.). Teichert included both spinose and nonspinose species in the crinoid genus *Calceolispongia*, and indicated that nonspinose species gave rise to spinose forms, from which nonspinose species were in turn derived (Teichert, 1949, p. 45). Sutton and Winkler (1940, p. 546) in reference to the inclusion of surface ornamentation among generic characters of *Ethelocrinus* by Kirk (1937, p. 605–606), remarked: "It is questioned whether the ornamentation of the plates of the dorsal cup is of sufficient importance to be used as a generic determinant." More recently Lane (1964, p. 681), in placing Strimple's genus *Metacromyocrinus* in synonomy under *Parulocrinus*, stated that "degree of ornament alone is doubtfully sufficient for establishment of a new genus . . .", and I am in full agreement with him.

Surface ornamentation of various types, particularly because it has not been demonstrated to be linked with significant modifications of the dorsal cup and arms, would also appear to be of no generic significance in erisocrinids. For this reason I feel that Strimple's *Tholiacrinus* and *Graffhamicrinus* are based on insufficient grounds to constitute valid and distinct genera, and I prefer to continue to include both ornamented and unornamented species in the genera *Endelocrinus* and *Delocrinus*.

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